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1. Introduction

With the increased territorial openness, factor mobility, and weakening of national protective measures, regions grow in importance as the spatial framework for economic competition. In this context, it is now recognised that knowledge - with learning as the most important process - constitutes one of the few important sources of competitiveness (cf. Camagni, 1991; Knight, 1995; Kuklinski, 1996; Lambooy, 1997; Morgan, 1997). The awareness of the social embeddedness of economic interaction (Grabher, 1993) has given a further impetus to the recognition of the region as a main territorial framework for learning and knowledge-based economic growth. The core argument is that tacit knowledge - with its crucial role in innovation - is strongly territorially-specific due to its person-embodiedness, social and cultural context, and therefore, need for proximity.

At the same time, the speed and complexity of knowledge development is higher than ever before. For example, there is an ongoing shortening of the lifecycles of products and time to market, and there is an increase in integration of products and services, in hybrid technologies, in functionality and in the number of product variants (customising) (den Hex-tog and Huizenga, 1997). These developments make attention for learning and knowledge-based growth even more pressing.

Over the past two decades, there has been an overwhelming research on innovation, with shifts in focus from merely innovation to innovation embedded in socio-cultural processes, institutions and networks. At the same time, there has been a move from a static to a dynamic approach to innovation (cf. Amin and Thrift, 1994; Bertuglia et al., 1997; Ratti et al., 1997). The recent 'passion' for learning regions may be seen as a further step in an attempt to uncover the basic processes that underlie the dynamics of innovation and regional economic growth.

The fact that the study of learning regions is relatively new explains the lack of a proper definition of learning regions as an analytical and testable concept. Associated with this is a shortage of cross-comparative research using a similar analytical framework leading to generic insights about learning regions. This contribution is an attempt to shed light on various underexposed conceptual and empirical issues, with particular attention for policy implications.

. The chapter is structured as follows. First, there is a conceptual exploration of learning regions and the learning involved, as well as conditions that enable the learning (Section 2). In order to stress diversity in learning, the paper proceeds with a discussion of different learning patterns associated with

particular product types (Section 3). An empirical study in various European cities serves to underline the latter diversity. (Section 4). This is followed by an exploration of the inherent complexity of learning regions in view of policies to improve their performance (Section 5). The latter findings are the input for a discussion of appropriate policy approaches and a discussion of research that needs to be done in order to arrive at a problem diagnosis (Section 6).

2. Conceptual Exploration

The concept of a learning region has two connotations. First, it refers to areas which have a body of knowledge (incorporated in research institutes and laboratories, higher education facilities) through which they can augment their productivity. Secondly, the concept refers to areas which through an active and comprehensive learning -- using this body of knowledge - try to get a better performance. This section explores important notions associated with learning regions, derived from the literature. It focuses first, on the purpose of learning, learning actors and learning networks, and the type of knowledge involved. This is followed by an exploration of the notion of learning capability.

The concept of learning regions is often associated with the need for an improved competitiveness in global markets. Thus, learning is not an aim in itself but serves to improve the actors' performance, although it is not always clear what this improved performance implies. It may refer to innovation and profitability, sustainability, or merely efficiency. The same vagueness holds for competition, such as the regions with which the competition is undertaken, the dimensions of competition, and the level of ambition (e.g., catching up, defeating), and hence, the associated learning effort. There is no doubt that part of the competitive strength of a region is determined by its natural, geophysical conditions, but part is contingent on indigenous managerial and learning skills. For example, regions can capitalize on their mainport function, and can even outperform others by exploiting their brainport potential.

With regard to the actors involved, learning certainly refers to regional firms. However, there are two reasons to include other categories of regional actors. First, learning for innovation takes increasingly place in different networks. Secondly, a part of the learning is rooted in the region, pointing to local authorities and supporting organisations as participants in learning. Thus, learning takes place at different

levels. When exploring what is learned, it is necessary to distinguish between two types of knowledge, i.e., explicit knowledge, embodied in machines, patents, documents, computer programmes, etc., and implicit knowledge embodied in human beings. The former is also named formal, codified knowledge and the latter tacit knowledge (Nonaka and Takeuchi, 1995). *Tacit* knowledge is rooted in practice and experience, and transmitted by apprenticeship and training through 'watching and doing' forms of learning, strongly 'coloured' by the social and cultural setting. It is not readily articulable and therefore, not easy communicable or tradable. Because of its wholly personal embodied nature it can only be traded through the labour market.

A part of tacit knowledge - connected with creativity and intuition - is now widely regarded as contributing most importantly to new combinations and new applications in product innovation, also named serendipity (den Hertog and Huizenga, 1997). Unexpected events, failure, and chance play an important role here. The awareness of this role of tacit knowledge is the basis for the articulation of the need for spatial proximity in innovation, and provides the ground for the attention for regions as an important spatial framework for learning (Morgan, 1997)

It needs to be emphasised that a different part of tacit knowledge produces routines. Routines are forms of rule-guided behaviour and are associated with incremental adjustments, close to pre-existing patterns. There is, however, a danger that routines make actors blind for new developments in the external environment. Accordingly, decision making tends to rely on old success stories and well-known solutions, even when the enviromnent is changing rapidly. In evolutionary approaches, this phenomenon is named path dependency (Arthur, 1994; Boschma and Lambooy, 1997; van Geenhuizen, 1998). In a situation of path dependency it is difficult to abandon once selected technologies or product-markets, etc., due to an accumulation of experience, routines, and capital in previous times. In other words, increasing returns from a previously selected behaviour makes a withdrawal from this behaviour less likely. The above observations point to at least two basic types of learning, namely leading to tacit knowledge that produces new combinations and applications, and leading to the removal of obsolete routines (*de-learning).*

The regional learning capability may be conceived of as a set of conditions that allow regional actors to learn and improve their performance. In adopting an integrated approach, various preconditions can be identified:

Consensus among the regional actors involved. Learning as a collective action needs to be accepted as a meaningful strategy. In addition, a certain level of trust is necessary, so that the benefits of learning are also contingent on its acceptance (Morgan, 1997; Nooteboom, 1996).

Networking to advance knowledge creation andjlow. Innovation is ***an interactive*** process within firms, between firms (suppliers, contractors), and between firms and various institutes (cf. OECD, 1996). Accordingly, networking is important to enhance serendipity.

Transformation *of* ***knowledge.*** Knowledge cannot always flow smoothly, due to differences in vocabulary and frameworks (Kamann, 1994; Williams and Gibson, 1990). Thus, transformation is necessary in flows, for example, between basic knowledge and applied knowledge, and between different disciplines.

Management *of* ***human capital.*** This refers to the resident population and the workforce in local firms. There need to be sufficient investment in skills for learning and skills for management, and for learning itself in art and science, at different levels, in different combinations, and by using formal as well as informal education.

Management *of* ***(public) stocks*** *of* ***knowledge.*** This includes the updating of archives, libraries, etc., and providing access to them.

Identification *of* ***new learning and knowledge needs. This*** condition is concerned with the monitoring of needs while anticipating new developments. Producing early warning signals is important here.

At a higher level, a key condition is the ***self-organising power*** to co-ordinate, preserve and renew the above indicated circumstances (cf. Amin and Thrift, 1994; Camagni, 1991; Ratti et al., 1997; Storper, 1995). This ability can only develop under a certain social and cultural coherence in the region, and sets of common aims and conventions (routines) that direct socio-economic behaviour. The common aims cover a wide range of interrelated fields, in accordance with the multi-faceted nature and setting of learning (networks), i.e. ranging from culture and education to the labour market and housing market (Knight, 1995). In particular regions such circumstances develop spontaneously but in other regions there ***seems*** to be a need for ***system integrators,*** such as a key person (natural leader) or a public-private agency (Brainanti and Senn, 1997).

Networking has been mentioned above as an important precondition for learning. It means an intentional participation of regional actors in networks, formation of new networks and dissolution of old ones. Learning networks can be defined as sets of connected exchange relations among actors involved in learning (cf. Cook, 1982, Hakansson, 1988). Network behaviour may be both co-operative and competitive. Like in many other networks, a number of components and aspects can be distinguished when using a structural approach. Accordingly, networking is about establishing linkages in order to acquire strategic ***resources*** for learning, such as human capital and ***finance*** for R&D, and ***information*** about the external environment. In the case of active networks, *activities are* undertaken such as R&D, brainstorming in group sessions, or simply working together and learn-by-doing. Networks can only become active learning networks if there is access to *facilities* (or channels) that enable learning interaction. Good examples are access to Internet and ***access*** to ***databanks. The interaction within*** and between networks is defined by the type of relationship involved, for example, simple and complex, symmetrical and asymmetrical, horizontal and vertical relationships. ***Power*** is an important aspect of networks, in view of steering. There is a different power within and between networks, with regard to access to resources and information, and the potential to exclude unwanted participants. Power can be seen as asymmetric exchanges, and dependence as the outcome of exerted power. One can observe a continuum of inter-organisational dependence in learning relationships, based on the type of compensation between the partners (Contractor and Lorange, 1988). In learning of firms, technological training (a fee as compensation) seems to be at one end and joint ventures (shares as compensation) at the other end of the spectrum.

Like other networks, learning networks are relatively closed. They may be almost entirely closed if the knowledge involved is strategic in nature and property rights do matter. There are two other important characteristics of learning networks, namely ***their spatial range*** and their socio-economic ***stability over time. The*** spatial range is variable and has increased in the past decades by using telecommunication. As previously indicated merely learning based on tacit knowledge needs physical proximity. Likewise, the stability over time is variable but seems to be relatively strong for tacit learning.

The above discussion underlines a differentiation in learning networks. But the common consideration of network actors is to increase knowledge in a more efficient way than without networks. Networks are thus vehicles for efficient behaviour. Network externalities may be derived from a higher speed, a greater coverage of knowledge, or synergy with other knowledge, etc. An interesting example of

externalities can be found in telecommunication networks. Here, positive externalities increase with the number of subscribers of the networks (Capello, 1997). In learning networks using telecommunication - such as in a discussion on a Website - this seems equally true but for learning networks based on face-to-face contact, the situation seems different. In the latter case, the optimum may be reached very quickly with an increasing number of participants as a result of diseconomies of density and limited potential of human beings to interact intensively with a great many actors.

3. Diversity in Patterns of Learning

Various authors point to differences between knowledge development according to the dominant culture and conventions (den Her-tog and Huizenga, 1997). In this context, Storper (e.g., 1996) highlighted the differences between ***product*** types, dependent upon the uncertainty in the markets and technologies involved. Illustrative examples are dedicated products and generic products. For dedicated products the critical condition is the existence of a community of specialists working on the (re)design of the product on very short time horizons, by using their tacit and customary knowledge of the product. Such an interpersonal community of knowledge developers is often based on traditionally acquired skills. A constant communication is necessary to carry out the specific technological development, with communication between producers and users as the most essential. This pattern not only applies to certain craft-based European industrial districts but also to the most specialist parts of high-technology industries, such as the non-merchant semiconductor production in Silicon Valley and the medical and scientific instruments industry in Orange County (near Los Angeles) (Storper, 1996).

By contrast, production of generic products depending upon highly specialised inputs, is based on formal processes of communication and learning. Knowledge development here relies on forms of communication that can be stretched over large distances, because the information is codified and the exchange is planned at regular intervals (business meetings, seminars, etc.). At the same time, however, for the development of their newest technology inputs, the producers are often tied to the same type of interpersonal communities of knowledge workers as in the previous case. This pattern means that regions dominated by such industries - like fine chemicals - may include formal learning and tacit learning, but may equally lack substantial knowledge development in situ (in a disconnected case). Thus, it may be

concluded that the importance of knowledge development and tacit learning in regional production may be different according to the product composition of firms in the region.

The previous discussion refers to different types of learning as relatively stable patterns. However, there may be a variation in the type and intensity of learning over time. One may distinguish between high levels of learning for a new product (design) or a new application followed by lower levels of learning for process innovation in order to reduce costs. Such time patterns are associated with the product lifecycle and various variations of this cycle (van Duijn, 1984; van Geenhuizen, 1993), or with what Nooteboom (1998) names the cycle of learning and organisation. It is needless to say that regional economies may show different compositions in this respect.

4. Intermezzo: Learning Networks in European City-regions

This section presents empirical results on the relevance of different learning networks and different sub-sectors of industry in the context of innovation. The results are based on a dataset that stems from the so-called URBINNO study and has been compiled by extensively interviewing (on a structured basis) manufacturing firms in the United Kingdom (208 firms) and in the Netherlands (33) and Italy (32) (Nijkamp et al., 1997). The firms have been selected in such a way that they represent sectors in early stages of the product lifecycle and sectors in later stages of this cycle. Accordingly, the former include firms in machinery and equipment (SIC 29), electric machinery and apparatus (SIC 31), medical precision and optical instruments, watches and clocks (SIC 33), and motor vehicles and trailers (SIC 34). In order to have a sufficient number of firms to cover later stages in the product lifecycle, the database includes textile, wearing and leather industries (SIC 17-19), and basic metal and metal industries (SIC 27 and 28). The results reported here, focus on the type of learning networks of these firms with the local (regional) university and the contribution of these networks to innovation, against the background of the different stages in the product lifecycle. In selecting the type of learning networks, attention has been paid to the activity (such as consultancy and participation in seminars) and the dependence (low in consultancy and short training courses, but high in joint ventures). Labour market links have also been included, i.e., recruitment networks with the local university.

Among networks based on a commercial agreement, the ones representing small dependence tend to dominate (Table 1). A good 30% of the firms make use of consultancy and testing (analysis) services at the university whereas only almost 10% have established a joint venture in view of knowledge sharing. Much more important than commercial links are links on training at the university. Around 50% of all firms make use of short training courses and training for technical qualifications. The latter means that universities constitute an essential actor in learning network in city regions in terms of enhancing skills and learning abilities of local firms. Training networks cause a low dependence of firms, whereas the impacts may last for a long time because these are embodied in human capital.

(insert Table 1)

The next step has been an explanatory investigation of innovative behaviour of firms by using logit analysis. The independent variables were participation in the previous three types of learning networks and the different manufacturing sectors (Annex 1). Another learning network has also been taken into consideration, namely training supplied by local (regional) public sector institutes or agencies. Due to an incomplete data-set, the logit analysis has to exclude a few indicators which may be expected to affect the propensity to innovate, such as size of firm and its growth rate. The results in Table 2 indicate that industries representing earlier stages in the product lifecycle contribute significantly to the propensity of a firm to innovate. In addition, training networks are positively related to innovation, but commercial learning networks and recruitment networks are not.

(insert Table 2)

Further, using the same database, a rough set analysis has been carried out. Rough set analysis is a fairly recent classification method of a so-called if-then nature. The analysis classifies objects into equivalence classes using available attributes which act as equivalence relationships for the objects considered. A class which contains only indispensable equivalence relationships is called a core. An attribute is indispensable if the classification of the objects becomes less precise when that attribute is left out. In order to carry out the classification, the values of the attributes of all the objects are subdivided into condition (background) attributes and decision (response) attributes. Rough set data analysis

basically evaluates the importance of attributes for a classification of objects, reduces all superfluous objects and attributes, discovers most significant relationships between condition attributes and the assignment of objects to decision classes, and represents these relationships, e.g. in the form of decision rules (See Slowinsky and Stefanowski (1993) in van den Bergh et al., 1997).

In the analysis here, the decision attribute (dependent variable) is whether the firm has introduced an innovation. The condition attributes (explanatory variables) are the same as in the above logit analysis. It appears that 71.4% of all firms can be classified into either the category innovation or category no innovation (Table 3). All condition attributes belong to the core, meaning that an exclusion of one of them would reduce the accuracy of the classification. In addition, the relative importance of the condition attributes can be investigated by dropping each time one of them from the core (the lower rows in Table 3). The results indicate that when Industry is excluded, the quality of the classification is lowest (only 30,4% can be classified). Further, of all learning networks, those concerned with Training, have the strongest contribution to the classification. These results confirm the pattern found on the basis of logit analysis.

(insert Table 3)

The previous empirical study has demonstrated a specific participation of firms in learning networks with local universities. There is a clear preference for low dependence relationships leading to long term impacts, i.e. (re)training of employees. The analysis has revealed that the latter networks tend to promote more innovation than commercial learning networks and recruitment links. However, the basic determinant of innovation appeared to be the manufacturing sector, i.e. relatively young sectors. The latter result confirms the need for attention for the sectoral composition of the regional economy, in view of the level and type of learning. The empirical research has also shown that rough set analysis is as a helpful method for explanatory research on learning networks, because it matches a situation of qualitative research based on interviews, using categorical (binary) data and often producing a relatively small number of observations.

5. Complex Nature from a Policy Point of View

This section focuses in on three characteristics of learning networks, in view of the potentials for steering. These characteristics are put forward in recent literature on policy making, i.e., diversity, closedness, and dependence (de Bruijn and ten Heuvelhof, 1995; Koppenjan et al., 1993). Further, attention is given to uncertainty in policy for learning networks by focusing on erratic moves and ill-predictable outcomes.

As indicated in the previous sections, learning networks show a high level of diversity. In some cases, this diversity is reinforced by a multi-layer network structure, in which actors at higher spatial levels influence the local level, such as multinationals deciding upon closure or opening of a local laboratory, and national governments deciding upon budgets for universities. Diversity often implies a different perception on problems and policy options and - in serious cases - a controversy. This may be true for the policy for learning-based economic growth itself. The policy seems a ***time-consuming*** endeavour without immediate gains in terms of new employment (Morgan, 1997). Accordingly, a policy for learning regions may face opposition form the labour unions or organisations for unemployed. A situation of limited consensus between relevant actors may cause small support for policy programs and lead to a partial implementation of instruments, with unexpected outcomes.

It has been mentioned previously that learning networks are ***closed*** to a certain extent. This means that they have their own frame of reference, and hence, are only susceptible to selected signals for steering. The ***dependence*** in learning networks may concern finance, for example, budgets to carry out research, or it may concern political support or protection, etc. For steering, a situation of dependence means that a powerful actor or network is a useful starting point for the implementation of change, because the other actors (networks) tend to follow.

The above characteristics cause a continuous change of learning networks within certain limits, such as the entry or exit of new actors, merging or dissolution of networks, and shifts in power. What also happens is that the content of policy problems change over time. Actors may redefine their problem, for example, due to a discrepancy between the original definition and emerging new insights or coalitions with other actors. For steering this means a need for monitoring and evaluation.

. It is important to note that the setting of knowledge creation tends to increase in complexity. There is a shift from hierarchical, disciplinary and division of labour-based knowledge production to a

mode in which research problems are set across disciplinary boundaries with a strong focus on application (OECD, 1996). In terms of organisation, there is a larger number of actors involved (aside from universities, research centres) with an increased emphasis on teams (consortia) working on a temporary basis.

There is not much experience with policies for learning regions, but there is experience with policies for innovative milieus, and with policies that face a multi-actor, multi-level and multi-disciplinary situation in a similar way, namely transport. Accordingly, we may expect that policies for learning networks tend to produce erratic moves and ill-predictable outcomes. First, decision making is still based on insufficient knowledge of the learning capability and learning itself. There is a limited empirical insight in conditions under which locaiised collaboration of firms facilitates learning, as well as conditions under which localised learning leads to innovation and improved profitability or employment growth (cf. Brouwer et al., 1993; Eskelinen, 1997; Oinas and Virkkala, 1997). There are also serious problems of reliable data and modelling on learning processes and knowledge in the (regional) economy. There is no standard production function of knowledge, no input-output recipe that tells the impact of a unit of knowledge on economic performance, etc. (OECD, 1996). This means that problem diagnosis and therefore, solutions suffer from a shortage of solid quantitative insights.

There is much more unknown about networks, particularly if a relatively long time dimension is taken into consideration. Network dynamics are dominated by non-linear relationships, including chaotic dynamics. In the latter case, small changes in the initial conditions or parameters may lead to disproportionally large dynamics, which may cause particular networks or regions to follow a different development path than others, e.g., suddenly become highly active in learning, while others may collapse or stagnate (cf. Kamann, 1997; Nijkamp and Reggiani, 1993, 1998).

Ill-predictability stems also from the nature of policy making itself. There is always a limited degree of rational and neutral behaviour in policy making, leading to imperfect procedures. Non-rational behaviour and subjectivity cannot be eliminated from the decision making process, particularly if high complexity is involved (cf. Hofstee, 1996). To mention a few potential imperfections: an ill-defined and ill-structured problem definition, a problem analysis that suffers from poor insights in the field at hand and in decisions in related fields, a disregarding of potentially relevant alternative solutions, and a shortage of evaluation of ongoing measures and developments (van Geenhuizen and Nijkamp, 1998b; Hall, 1990; Rietveld, 1993).

While coping with the its creative potential to acquire, digest, and deploy strategic knowledge in a relatively more efficient way that its competitors, a region needs to become aware of the above imperfections and uncertainty in policy making. Aside from reducing uncertainty, an important strategy is to use uncertainty in a creative way in order to come to new policy solutions.

6. Policy Approaches

This section discusses first, important policy approaches that match the network and interaction nature of regional learning, i.e., network management and participatory policy making (de Bruijn and ten Heuvelhof, 1995). It proceeds with a discussion of research that is necessary to underpin policy initiatives.

Network management means to influence the diversity, dependency, and closedness of networks in such a way that opportunities for change emerge. Accordingly, this is a way of meta-steering leading to changes in the network structure which in further steps allow for an effective use of instruments (the operational level). For example, an important characteristic of the learning capability is the fragmentation of intermediating networks (cf. Bartels, 1996). In this case, network management means first to let these networks merge or co-operate in one single 'platform', and then to implement measures by targeting the 'platform' in order to improve performance.

Further, in an interactive approach there is strong attention for *participatory policy making*. This type of policy making is generally oriented to achieve consensus between different actors, in order to increase support for policy solutions. However, there may be various specific aims (Ester et al., 1997). The aim may be merely to advice and inform about actors' interests and values. In this case, the method works through citizen consultation, workshops, and conferences where actors can disclose their information, opinions and values. An important process result would be that the actors cross the borders of their own frame (frame reflective learning), and establish new networks and communication based on a change of attitude. There are also participatory approaches in which actors actively contribute to the (re)design of policy solutions. The latter seems to be essential in policies for learning regions because learning as a common action cannot work without full support from all local actors. A specific form of participatory policy making is *creative steering*, developed to arrive at new solutions in policy making

for traffic infrastructure. Creative steering takes chaos as a starting point with contributions from all actors that are willing to participate. Originality is a major aim, not being right or wrong in argumentation. The results of creative steering may be elaborated in various rounds in such a way that a policy document is made with a sufficiently strong status (de Rooij, 1996).

Except for housing and community development and policies for transport infrastructure, there is not much experience with participatory approaches. A preliminary analysis suggests the influence of the following factors on the success of these approaches (van Geenhuizen and Nijkamp, 1998b):

Motivation; a sufficient number of relevant actors need to be convinced of the problem and convinced of co-operation as an important way to arrive at solutions.

Transparency of aims and procedures, and *trust*, meaning that stakeholders are convinced of a potentially genuine participation (as opposed to symbolic participation).

Removal of (impacts from) barriers between stakeholders, such as connected with 'languages' and types of argumentation.

An adequate role of the process manager as the organiser of communication and interaction between stakeholders (dependent upon the aim of the participation).

A *short time* between the participation and implementation of results. It seems that changes in attitude of actors are completely gone after two years.

The above conditions indicate that participatory policy making deserves a careful preparation, in terms of a clarification of the procedures to be followed (including competence and authority). More importantly, the selection of the appropriate actors and networks, and a preliminary definition of the problem including the level of aggregation and spatial scale, need a cautious preparatory work. This observation brings the attention to the empirical research that needs to be done.

There is research needed on the specificity of the regions in order to design a policy that matches the local situation. Various research lines can be sketched in a (self)diagnosis:

(1) To establish a picture of the inter-relatedness of the regional economy, using micro-level data on 'input, output, and origin destination, etc., in a filiere or chain-like approach (Kamann, 1997). This

analysis also reveals ownership structures, capital flows, knowledge flows, etc., in such a way that it provides indications for the regional embeddedness of firms.

(2) To focus in on the relevant learning networks to which regional firms are tied, and the key characteristics of these networks, including spatial range.

(3) To explore the links between firm collaboration, learning processes and innovative behaviour of firms, particularly the circumstances under which localised collaboration leads to innovation and a better performance of firms. In this respect, the composition of the regional economy in terms of types and level of learning (related to product types) calls for attention.

(4) To identify bottlenecks in learning networks and in the preconditions for their functioning. For example, to uncover the (lack of) socio-cultural coherence in the region. Cognitive maps of actors covering both the territorial dimension and the industrial dimension may be used (Kamann, 1997).

(5) To analyse recent 'shocks' in the regional economy (such as closure of a large firm) and to uncover the composition of responses of key actors, i.e., in terms of wishes to protect an old technology (based on routines) or wishes to restructure the industry aimed at the introduction of new key technologies. This type of analysis serves to find out whether the region tend to a lock-in situation (Grabher, 1993).

(6) To identify labour market dynamics which influence localised learning processes, e.g., the match between labour demand and supply, in- and out-migration of knowledge-based firms, and the supply of training programs. To identify housing market dynamics connected with localised learning processes, such as the match between demand and supply of housing for knowledge workers, and the in- and out-migration of the latter (Knight, 1995).

(7) To design forms of participatory policy making that fit the local (problem) situation, e.g., in view of the distribution of power.

The research indicated above can certainly not be done overnight. Given a situation in which various future processes and policy outcomes remain uncertain there is a need to introduce a significant *flexibility* in steering and monitoring of ongoing developments.

7. Concluding Comments

Learning regions is an attractive concept because it calls for attention for the institutional side of regions. The concept suffers, however, from some vagueness, particularly in the context of competition between regions. In addition, various cause-effect chains are not very well tested. Here are interesting opportunities for cross-comparative regional research using a common analytical framework.

Learning takes place at different levels, e.g., in and between firms, and in local govemments and regional authorities. There is learning for product innovation, de-learning of old routines, and there is learning of learning skills. The diversity in the networks involved cause a large differentiation in the regional composition of learning. Diversity is partly associated with product types of local firms. In an empirical part, this study could demonstrate a differentiation in innovation based on the stage in the lifecycle of the products involved. In addition, it could be shown that only selected learning networks contribute to innovation. Within a broad range of networks - covering different activities and a different dependence - training networks appeared to be the most important.

In general, policies for learning regions have to deal with diversity, closedness and dependence in a dynamic setting. In accordance with the network (interaction) nature and need for consensus, policy approaches preferably follow models of network management, including participatory approaches to increase support. In this way, policy making becomes a specific type of regional learning itself. One policy line seems undisputed, namely a sufficient investment in human capital. Other policy lines are dependent on the diagnosis of the specific shortcomings of the learning capability of individual regions.

The mission of the region, i.e., to improve its learning capability, will yield important results mainly on the medium term, although particular measures may trigger the pace of change. In the mean time it would make sense to carry out a number of pilot projects in order to produce some short term results in particular areas, and to test through a systematic monitoring of ongoing developments whether the long term objectives are still valid.

ANNEX 1

Independent Variables in the Logit Analysis (Table 2):

Sector
IND29
IND31
IND33
IND34
IND17
IND18
IND19
IND27
IND28
Learning Networks
LINKCOMM
LINKTRAI
LINKRECR
ASSTRAIN

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References

Amin and Thrift *(eds)* (1994) *Globalization, Institutions, and Regional Development in Europe.* Oxford: Oxford University Press.

Arthur, W.B. (1994) *Increasing returns and path dependency in the economy. Ann* Arbor: University of Michigan Press.

Bartels (Bureau Bartels) (1996) Establishing Trust. A Knowledge and Innovation Strategy for the Region of Rotter-dam. Utrecht: Bureau Bartels.

Bergh, J.C.J.M van den, Button, K., Nijkamp, P. and *G.* Pepping (1997) ***Meta-Analysis for Meso*** *Environmental Policy.* Dordercht: Kluwer.

Bertuglia, C.S., Lombardo, S. and P. Nijkamp *(eds) Innovative Behaviour in Time and Space.* Berlin: springer.

Boschma, R. and J. Lambooy (1998) Economic evolution and the adjustment of the spatial matrix of regions. In: Dijk, J. van, and F. Boekema *(eds) Innovation in Firms and Regions.* Assen: Van Gorcum. pp 121-137.

Bramanti, A. and L. Senn (1997) Understanding Structural Changes and laws of Motion of Milieux: A Study on Northwestern Lombardy. In: Ratti. R., Bramanti, A. and R. Cordon (eds) ***The*** *Dynamics of Innovative Regions:* ***The GREMI Approach.*** Aldershot: Ashgate. pp. 47-73.

Brouwer, E., Kleinknecht, A. and J.O. Reijnen (1993) Employment growth and innovation at the firm level. *Am* empirical study. *Evolutionary Economics* 1993 (3): 153-159.

Bruijn, J.A. de, and E.F. Ten Heuvelhof (1995) *Network Management. Strategies, Instruments and* Norms (in Dutch). Utrecht: Lemma.

Camagni, R *(ed)* (1991) *Innovation Networks: Spatial Perspectives.* London: Belhaven.

Capello, R (1997) Telecommunication network externalities and regional development: policy implications. *In:* Rietveld, P. and *C. Capineri* (eds) *Networks in Transport and Communications A* ***Policy Approach.*** Aldershot: Ashgate. pp. 13-36.

Contractor, F. and P. Lorange (1988) *Cooperative strategies in international business.* Lexington MA: Lexington Press.

Cook. K. (1982) Network structures from exchange perspective. In: Marsden, P. and Lin, N. (eds) *Social Structure and Network Analysis. New* York: Tree Press. pp. 177- 199.

Duijn, J.J. van (1984) Fluctuations in innovations over time. In: Freeman C. (ed) *Lonf Waves in the World Economy.* London: Frances Pinter. pp. 19-30.

Eskelinen, H. (1997) *Regional Specialisation and Local Environment. Learning and Competitiveness.* Stockholm: NordREFO.

Ester, P., Geurts, J. and M. Vermeulen (eds) (1997) *Designers of the Future* (in Dutch). Tiburg: Tilburg University Press.

Geenhuizen, M. *van* (1993) *A Longitudinal Analysis of the Growth of Firms. The Case of the Netherlands.* Rotterdam: Erasmus University (Ph.D. thesis).

Geenhuizen, M. van (1998) An Evolutionary Approach to Firm Dynamics: Adaptation and Path Dependency. In: Lipshitz, *G.*, Rietveld, P. and D. Shefer (eds) *Regional Development in an Age of Structural Economic Change.* (forthcoming)

Geenhuizen, M. van, and P. Nijkamp (1998a) Improving the Knowledge Capability of Cities: The Case of Mainport Rotterdam. *Int. Journal of Technology Management* 15 (6/7): 69 l-709.

Geenhuizen, M. van, and P. Nijkamp (1998b) Regional and Urban Policy Beyond 2000: New Approaches with Learning as Device. Research Memoranda. Amsterdam: Free University.

Grabher, *G.* (ed) (1993) *The Embedded Firm. On the Socioeconomics of Industrial Networks.* London: Routledge.

Hall, P. (1990) Great Planning Disasters Revisited. London: UCL Department of Geography.

Hofstee, W.K.B. (1996) Psychological factors in decision making (in Dutch). In: Nijkmap, P., Begeer, W. and J. Berting *(eds) Considering Complexity in Decision Making: A Panoramic View. The* Hague: SDU Uitgevers. pp. 49-58.

Hertog, F. den, and E. Huizenga (1997) *The Knowledge Factor. Competition as a Knowledge-Based Firm* (in Dutch). Deventer: Kluwer.

Kamann, D.J.F. (1994) Spatial Barriers and Differentiation of Culture in Europe. In: Nijkamp, P. (ed) *New Borders and Old Barriers in Spatial Development.* Aldershot: Avebury. pp. 35-63.

Kamann, D.J.F. (1997) Policies for Dynamic Innovative Networks in Innovative Milieux. In: Ratti. R., Bramanti, A. and R. Gordon (eds) *The Dynamics of Innovative Regions: The GREMI Approach.* Aldershot: Ashgate. pp. 367-391.

Koppenjan, J.F.M, Bruijn, J.A. de, and W.J.M. Kickert (1993) *Network Management in Public Administration. Potentials for public steering in policy networks* (in Dutch). The Hague.

Knight, R.V. (1995) Knowledge-based development: policy and planning implications for cities. *Urban Studies 2:* 225-260.

Kuklinski, A. *(ed)* (1996) *Production of Knowledge and the Dignity of Science.* Warsaw: EUROREG.

Lambooy (1997) Knowledge production, organisation and agglomeration economies. *Geojournal* 41, 4: 293-300.

Maillat, D., Lechot, G., Lelocq, B. and M. Pfister (1997) Comparative Analysis of the Structural Development of Milieux: The Watch Industry in the Swiss and French Jura Arc. In: Ratti, R., Bramanti, A. and R. Gordon *(eds) The Dynamics of Innovative Regions.* Aldershot: Ashgate. pp 109-137.

Morgan, K. (1997) The Learning Region: Institutions, Innovation and Regional Renewal. *Regional Studies* 31 (5): 491-503.

Nanoka and Takeuchi (1995) *The knowledge creating company. How Japanese companies create the dynamics of innovation*

Nijkamp, P. (1996) Policy and Policy Analysis: Narrow Margins versus Broad Missions (in Dutch). In: Nijkamp, P., Begeer, W. and J. Berting (eds) *Considering Complexity in Decision Making: A Panoramic View.* The Hague: SDU Uitgevers. pp. 129-146.

Nijkamp, P. and A. Reggiani (1995) *Interaction, Evolution and Chaos in Space.* Amsterdam: Elsevier.

Nijkamp, P., Kangasharju, A., and M. van Geenhuizen (1997) Local and innovative behaviour: A meta-analytic study on European cities. In: Lipshitz, *G.,* Rietveld, P. and D. Shefer (eds) *Regional Development in an Age of Structural Economic Change.* (forthcoming)

Nijkamp, P. and A. Reggiani (1998) *The Economics of Complex Systems.* Amsterdam: Elsevier.

Nooteboom (1996) Trust, Opportunism and Governance: A Process and Control Model. *Organizational Studies nr 17.* pp. 985-1010.

Nooteboom (1998) Innovation, location and firm size. In: Dijk, J. van, and F. Boekema (eds) *Innovation in Firms and Regions. Assen:* Van Gorcum. pp 75-79.

Oinas, P. and Virkkala, S. (1997) Learning, Competitiveness and Development. In: Eskelinen, H. (ed) *Regional Specialisation and Local Environment. Learning and Competitiveness.* Stockholm: NordREFO. p. 263-277.

Ratti, R., Bramanti, A. and R. Gordon (eds) (1997) *The Dynamics of Innovative Regions. The GREMI Approach.* Aldershot: Ashgate.

Rietveld, P. (1993) Policy analysis in traffic, transport and spatial planning; improving the quality of decision making? (in Dutch) In: Rietveld, P. and H. Boerenbach (eds) *Policy analysis and decision making in traffic and spatialplanning.* The Hague: Platform Beleidsanalyse.

Simmie, J. (ed) (1997) *Innovation, Networks and Learning Regions?* London: Jessica Kingsley.

Storper, M. (1996) Innovation as Collective Action: Conventions, Products and Technologies. *Industrial and Corporate Change* 5(3): 76 l-790.

Williams, F. and D.V. Gibson (eds) (1990) *Technology Transfer. A Communication Perspective.* Newbury Park: Sage.

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Table 1 **Learning networks of firms (a) with local (regional) universities and colleges**

Type of activity	Dependence (b)	Participation (% share of all firms)
Commercial networks		
Consultancy		32.9
Testing (analysis)		31.6
Subcontracting	+	13.9
Joint ventures	++	9.3
Training networks		
Short courses	-	46.0
Courses for technical qualification	-	51.0
Courses for management qualification	-	36.1
Seminars	-	30.9
Recruitment networks		
Technical staff	+	27.0
Management staff	+	14.0

a. N = 273 (non response of around 8%).
b. - = low; +=high;++=velyhigh.

Table 2 **Results of a Logit Analysis (a)**

-2Log Likelihood: 367.30157 (restricted model)
-2Log Likelihood: 323.4 1300 (full model)

Variable	Estimated Coefficient	Standard Error
IND29DUM	1.0613	.3427
IND31DUM	1.2892	.4229
IND33DUM	1.2720	.5115
IND34DUM	2.0964	.5507
LINKTRAI	.9321	.2799
Constant	-1.6011	.2635

a. Based on Theils sequential elimination procedure

Table 3 **Results of Rough Set Analysis (a)**

	Innovation	No Innovation	Quality Of Classification
Classification with core attributes	***69***	126	0.714
Classification with a temporary reduced condition attribute			
Industry	26	57	0.304
Training Links	60	104	0.601
Assistance	56	110	0.608
Commercial links	56	112	0.615
Recruitment Links	61	118	0.656

a. Lower Approximations for Rough Set Classes.